UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/805,841	03/22/2004	Jeffrey L. Duerk	CWRU-P01-049	1712

7590 02/04/2005

Richard J. Minnich, ESq.
Fay, Sharpe, Fagan, Minnich & McKee, LLP
Seventh Floor
1100 Superior Avenue
Cleveland, OH 44114-5582

EXAMINER	
FETZNER, TIFFANY A	
ART UNIT	**PAPER NUMBER**
2859	

DATE MAILED: 02/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

OK

Office Action Summary	Application No.	Applicant(s)	
	10/805,841	DUERK ET AL.	
	Examin r	Art Unit	
	Tiffany A Fetzner	2859	

-- Th MAILING DATE of this communication appears on th cov r sh t with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 March 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-23 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-23 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 03/22/2004 is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. Corrected drawings are required in this application because the official draftsperson has objected to the drawings submitted on March 22nd 2004. [See the attached PTO 948 form of the Official Draftsperson's Review].

Specification

2. The disclosure is objected to because of the following informalities:

A) The specification is objected to because on page 3 in the detailed description of the invention paragraph [0018] the applicant states that the method disclosed is "conventional" (i.e. known from the prior art) in creating an off-resonance frequency map with spiral imaging. Therefore applicant has admitted each of the steps in paragraphs [0017] through [0019] in the detailed description of the invention are prior art. A clear statement as to what applicant has invented in contrast to the "conventional" prior art is not provided. Clarification is needed. Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claims 1-10**, and **12-20** are rejected under **35 U.S.C. 102(b)** as being anticipated by **Zhang et al.**, US patent 6,263,228 B1 issued July 17th 2001.

5. With respect to **Claim 1**, **Zhang et al.**, teaches and shows "A method of chemical species suppression for MRI imaging of a scanned object region" [See col. 3 line 39 through col. 10 line 20 where fat and water NMR signals are suppressed or enhanced to produce fat images, and water images from single scan single point Dixon MRI sequences.] "comprising: acquiring K space data at a first TE;" [See figure 2a col. 8 line 65 through col. 9 line 22 where the first TE is

9.5 ms.] “acquiring K space data at a second TE;” ;” [See figure 2b col. 8 line 65 through col. 9 line 22 where the second TE is 28.5 ms.] “reconstructing images having off resonance effects’; [See the water-fat out of phase images of figures 4, 5 series (A); col. 3 line 40 through col. 10 line 20.] “estimating off resonance effects at locations throughout the reconstructed image;” [See col. 5 line 1 through col. 6 line 63; col. 9 lines 23=56] “and determining the first and second chemical species signals at image locations of the scanned object from the acquired signals” [See col. 9 lines 23 through col. 10 line 20; col. 7 lines 3 through col. 8 line 2;] “and correcting for blurring resulting from off resonance effects due to B.sub.0 inhomogeneity.” [See abstract, col. 2 lines 52-56; col. 3 line 40 through col. 4 line 68].

6. With respect to **Claim 2, Zhang et al**., teaches and shows “the steps of acquiring K space data at the first TE and the second TE comprise acquiring signal components from first” (i.e. fat) “and second” (i.e. water) “chemical species”, [See col. 4 line 51 through col. 10 line 20, abstract, figures 2a, 2b, 3, 4a-4c, 5a-5c]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 2** and need not be reiterated.

7. With respect to **Claim 3**, **Zhang et al**., teaches “acquiring K space data at a third TE”. [See the plurality of TE times taught by cool. 9 3-30.] The same reasons for rejection, that apply to **claim 1** also apply to **claim 3** and need not be reiterated.

8. With respect to **Claim 4, Zhang et al**., teaches and shows “acquiring K space data at the third TE comprises acquiring signal components from the first” (i.e. fat) “and second” (i.e. water) “chemical species”. [See col. 9 line 3 through col. 10 line 20; col. 6 line 66 through col. 9 line 2; figures 2a, 2b, 3, 4a-c, 5a-c]. The same reasons for rejection, which apply to claims 1, **3** also apply to **claim 4** and need not be reiterated.

9. With respect to **Claim 5, Zhang et al**., teaches and shows “estimating off resonance effects comprises generating an estimated field map” [See figures 4a,

5a, col. 1 lines 15-29]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 5** and need not be reiterated.

10. With respect to **Claim 6, Zhang et al.**, suggests the steps of: "a) estimating the off resonance effects for a first location" [See figures 4a, and 5a where fat and water out of phase images of a knee and the surrounding leg tissue are shown.] "comprising: i. providing a frequency", [See col. 1 lines 22-24] "ii. estimating signal components for first" (i.e. fat) "and second" (i.e. water) "chemical species at the provided frequency", [See col. 1 lines 22-24; col. 3 line 40 through col. 10 line 20; figures 3, 4a and 5a.] **Zhang et al.**, also teaches "iii. calculating an estimated signal of the first and second chemical species at the provided frequency, [See col. 1 lines 22-24; col. 3 line 40 through col. 10 line 20; figures 3, 4a and 5a; and the equations of col. 4 line 22 through col. 6; and the equations of col. 9 line 34 through col. 10 line 13] The step of "iv. calculating the difference between the estimated and acquired signal at the provided frequency", is taught and shown by the mathematical explanations of col. 4 line 18 through col. 10 line 13} The step of: "v. repeating steps i. - iv. for different frequencies to find the frequency that minimizes the difference for the first location; and b. repeating steps i. - v. for other locations in the estimated field map" is taught by the polynomial fitting and region growing techniques of col. 5 and col.. 6; for the particular frequency of col. 1 line 15 through col. 2 line 51; of each point in the image of the plurality of images produced in figures 4a-c and 5a-c. The same reasons for rejection, which apply to claims 1, **5** also apply to **claim 6** and need not be reiterated.

11. With respect to **Claim 7, Zhang et al.**, teaches that "a region growing" is used :to create a frequency field map for the scanned object". [See abstract, col. 5 lines 10-14; col. 6 line 7 through col. 10 line 20] The same reasons for rejection, that apply to **claims 1, 5, 6** also apply to **claim 7** and need not be reiterated.

12. With respect to **Claim 8, Zhang et al.**, shows "a frequency determined region" (i.e. the imaged regions of the patient) as the value of fj that minimizes

Dlocal where Dlocal takes the single minimum in the Dlocal-fj plot." [See figures 4b-c, 5b-c, where the fat only and water only pixels are shown and correction for Bo inhomogeneities has been performed by phase unwrapping as per col. 4 lines 50-68.]The same reasons for rejection, that apply to **claims 1, 5, 6, 7** also apply to **claim 8** and need not be reiterated.

13. With respect to **Claim 9, Zhang et al**., teaches "expanding the frequency determined region" (i.e. via the region growing algorithm" so that the frequency field map can be created for the scanned object region" [See abstract, col. 5 lines 10-14 col. 6 line 7 through col. 10 line 20.] The same reasons for rejection, that apply to **claims 1, 5, 6, 7, 8,** also apply to **claim 9** and need not be reiterated.

14. With respect to **Claim 10, Zhang et al**., shows from col. 7 lines 3-45 where "pure" pixel, "water pixels" and "fat pixels" are taught; and figures 4b-c and 5b-c the step of "finding the correct frequency fj at each pixel" (i.e. because fat and water pixels for the imaged frequency are determined "in a "frequency to-be-determined region" (i.e. figures 4a, 5a) "which abuts the 'frequency determined'" region [of figures 4b-c and 5b-c. The same reasons for rejection, that apply to **claims 1, 5, 6, 7, 8, 9,** also apply to **claim 10** and need not be reiterated.

15. With respect to **Claim 12, Zhang et al**., teaches "a. estimating the off resonance effects for a first location comprising: i. providing a frequency", ii. estimating signal components for first and second chemical species at the provided frequency", for the same reasons given with respect to **claim 6**, that need not be reiterated. **Zhang et al**., also teaches the feature of "iii. determining whether the signal components have the same or opposite phases at the provided frequency", [See col. 4 line 18 through col. 10 line 20].

16. Additionally, **Zhang et al**., teaches "repeating i. - iii. for another frequency if the signal components do not have the same or opposite phases, and b. repeating steps i. - iv. for other locations in the estimated field map" because S is a signal at a particular frequency and figure 3 shows that the loop of steps is repeated for each pixel in k-space and each frequency S of each pixel until all

components of an image have been resolved. The same reasons for rejection, that apply to **claims 1, 5, 6** also apply to **claim 12** and need not be reiterated.

17. With respect to **Claim 13, Zhang et al**., teaches "using an off resonance correction method to eliminate the effects of local Bo inhomogeneity on the first chemical species" (i.e. fat), and produce clear fat images. [See figures 4c, 5c, col. 4 lines 50-68]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 13** and need not be reiterated.

18. With respect to **Claim 14, Zhang et al**., teaches, "using an off resonance correction method to eliminate the effects of local Bo inhomogeneity on the second chemical species. (i.e. the water) [See figures 4b, 5b, col. 4 lines 50-68]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 14** and need not be reiterated.

19. With respect to **Claim 15, Zhang et al**., teaches "using an off resonance correction method" (i.e. single point, single scan Dixon method) "to eliminate the effects of local Bo inhomogeneity on the first chemical species" (i.e. the fat), "and the second chemical species", (i.e. the water) of the **Zhang et al**., experiment [See figures 4a-c, 5a-c col. 3 lines 40 through col. 10 line 20, abstract] The same reasons for rejection, that apply to **claim 1** also apply to **claim 15** and need not be reiterated.

20. With respect to **Claim 16, Zhang et al**., teaches and shows from figures 4a-c and 5a-c the step of "reconstructing images of the first and second chemical species based on frequencies indicated in the frequency field map at each pixel location having blurring due to the off resonance effects of local Bo inhomogeneity." [See figures 4a-c and 5a-c; col. 3 line 40 through col. 10 line 20]. The same reasons for rejection, that apply to **claims 1, 5,** also apply to **claim 16** and need not be reiterated.

21. With respect to **Claim 17, Zhang et al**., teaches that "the first chemical species is water and the second chemical species is fat" [See figures 4a-c and 5a-c; col. 3 line 40 through col. 10 line 20] The same reasons for rejection, that apply to **claim 1,** also apply to **claim 17** and need not be reiterated.

22. With respect to **Claim 18**, **Zhang et al**., shows the step of "demodulating the first and second chemical species images with demodulation frequencies f.sub.l and f.sub.l+j.sub.s to create locally deblurred images of the first and second chemical species respectively", because he shows deblurred fat only and water only images. [See figures 4b-c, 5b-c]. The same reasons for rejection, that apply to **claims 1, 5, 16,** also apply to **claim 18** and need not be reiterated.

23. With respect to **Claim 19**, **Zhang et al**., teaches and shows the feature of "reconstructing the entirely deblurred first chemical species image by combining the deblurred regions of first chemical species images from each local frequency, f.sub.l," via the phase shift " in the frequency field map. [See figures 4b-c, 5b-c; and the algorithm and equations of col. 3 line 5 through col. 10 line 20]. The same reasons for rejection, that apply to **claims 1, 5, 16, 18,** also apply to **claim 19** and need not be reiterated.

24. With respect to **Claim 20**, **Zhang et al**., shows from the images of figures 4b and 5b the step of "reconstructing the entirely deblurred second chemical species" (i.e. the water) "image by combining the deblurred regions of second chemical species images from each local frequency, fs, in the frequency field map. [See the deblurred phased unwrapped water pixels calculated at each location's specific frequency and the equations throughout col. 3 line 40 through col. 10 line 20.] The same reasons for rejection, that apply to **claims 1, 5, 16, 18,** also apply to **claim 20** and need not be reiterated.

Claim Rejections - 35 USC § 103

25. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

26. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

27. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

28. **Claims 1-2** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsai et al.,** US patent 6,215,306 B1 issued April 10th 2001in view of **Chen et al.**, US patent 6,084,408 issued July 4th 2000.

29. **Claims 1, 2, 5-9** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsai et al.,** US patent 6,215,306 B1 issued April 10th 2001in view of **Pauly et al.**, US patent 5,402,067 issued March 28th 1995.

30. **Claims 1-16, 22-23** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsai et al.,** US patent 6,215,306 B1 issued April 10th 2001.

31. With respect to **Claim 1**, **Tsai et al.,** teaches and shows A method of MRI imaging of a scanned object region" [See col. 1 line 11 through col. 2 line 9] comprising the step of "acquiring K space data at a first TE;" [See col. 2 line 12 through col. 3 line 56 where the minimum TE, of col. 3 line 39 which represents the minimum interecho spacing / the minimum time period of a data acquisition is a first TE. See also figure 1a which shows an interleaved spiral k-space trajectory data acquisition from the origin with a constant TE for each spiral segment.] Additionally, **Tsai et al.,** teaches and shows the step of "acquiring K space data at a second TE;" [See Figures 4, 3a, 3b which shows a second "Increased TE" as

opposed to the "minimum TE"; col. 3 line 15 through col. 5 line 16 where the use of off centered spiral trajectories requires an additional TE increased by the interval of time from the beginning of the data acquisition to the time the trajectory passes through the k-space origin, which corresponds to an interval less than 1ms in the **Tsai et al.,** method.

32. **Tsai et al.**, shows in figures 8a, 8b, 8c, 1a, 1b, 2a, and 2b the step of "reconstructing images having off-resonance effects;". [See also col. 2 line 55 through col. 3 line 29; col. 4 line 22 through col. 5 line 17.] The step of "estimating off resonance effects at locations throughout the reconstructed image" is taught and shown in col. 2 line 55 through col. 5 line 15; and figures 1 through 9 where the deviations between ideal sampling positions (circles) and actual sampling positions (stars) is identified as δk with an arrow in figure 3b. The examiner considers the deviations prior to correction processing to be observable "estimations of off-resonance effects". **Tsai et al.**, also teaches the step of correcting for blurring resulting from off resonance effects due to Bo inhomogeneity". [See col. 3 lines 46-56].

33. **Tsai et al.**, also teaches that in MRI applications whose desired quantity is a function of the ratio of two measurements (e.g. measurements of t1, the longitudinal spin-lattice relaxation, and t2, the spin-spin transverse relaxation), the shading (i.e. "blurring, off-resonance") artifacts (i.e. of a 10cm. homogeneous sphere phantom col. 4 lines 23-25) are cancelled out in post processing, while the phase contrast method which relies on the phase-difference of the measured signal from a flowing sample (i.e. such as blood or moving liquid, or steady flow in a glass tube as in col. 4 lines 35-39) is subject to many shading (i.e. "blurring, off-resonance") artifacts depending on the polarity of the flowing spins, and that this problem can be overcome simply by the use of off-centered spiral trajectories in resolving the flowing sample signal from the tube or vessel, or water surrounding the flow. [See **Tsai et al.**, col 4 line 35 through col. 5 line 15.] This teaching is important because **Tsai et al.**, lacks directly teaching that the method is "for chemical species suppression". However since the flowing signal

can be distinguished from the surrounding tube or vessel, or water, using the PC (i.e. phase contrast) method with the **Tsai et al.**, off-centered spiral imaging, where the conventional center-spiral imaging methods fail as a result of the off-resonance blurring, at least some "chemical species suppression" of the signal from the surrounding tube or vessel, or water, is intrinsically occurring in the **Tsai et al.**, reference, because **Tsai et al.**, directly implies the feature of "determining the first" (i.e/ the steady flow") "and second chemical species" (i.e. the surrounding tube or vessel, or water, using the PC (i.e. phase contrast) method) "signals at image locations of the scanned object from the acquired signals". [See **Tsai et al.**, figures 1 through 9' abstract, col. 3 line 15 through col. 5 line 15] The examiner notes that the ability to use the PC method to distinguish imaged signals without the off-centered resonance spirals affecting the magnitude of the reconstructed images is an advantage of the **Tsai et al.**, method. [See **Tsai et al.**, figures 1 through 9' abstract, col. 3 line 15 through col. 5 line 15]

34. Additionally in the alternative the **Chen et al.**, reference teaches specifically using "at least two different interecho spacing times for each wait-time (i.e. each "delay") within the NMR / MRI pulse sequence [See abstract, col. 1 lines 10-37;) to distinguish between hydrocarbons / oil and water [See abstract, col. 1 lines 10-37; col. 4 line 49 through col. 5 line 21] , which directly suggests the feature of "chemical species suppression" with the use of two different TE's.

35. Further in the alternative **Pauly et al.,** teaches "chemical species suppression" because **Pauly et al.,** teaches that by using interleaved spiral trajectories that off-resonance effects can be placed in the sidelobes of the spin-echo signal to facilitate suppression in the detected signals. [See abstract, col. 2 lines 42-44] Additionally **Pauly et al.,** teaches that the segmented spiral trajectories off-resonance behavior can be utilized to suppress the lipid / fat/ oil signal from the detected image signal. [See col. 4 lines 53-68]. Additionally the use of at least two different TE's in **Pauly et al.,** is directly suggested from figures 3, 4, and 5b where the interecho spacing is shown to change.] The feature that identifiable features, are always reconstructed at the correct location in the

images of a normal volunteer, even with the effect of off-resonance blurring occurring in **Pauly et al.,** [See **Pauly et al.,** col. 7 line 3 through col. 8 line 6] directly suggests the ability to "determining the first and second chemical species" (i.e. features) signals at image locations of the scanned object from the acquired signals".

36. It would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teaching of **Tsai et al**., with the teaching of **Chen et al**., or **Pauly et al.,** because the ability to separate, and / or suppress, distinguish and identify the different chemical species of a given sample is a main purpose of MRI and NMR imaging and permits tomographic and spectroscopic diagnostically usable magnetically resonant images to be produced. In well bore technology (**Chen et al.**,) the ability to determine oil from water helps determine the economic value of the wellbore; in medical imaging (i.e. **Pauly et al., Tsai et al**.,) the ability to determine fat in a blood vessel from flowing blood which has a high water signal, or other anatomical features assists in imaging the heart, or brain, or circulatory system of a patient in order to determine when a patient's arteries may be clogged with plaque / fat, or are normal and healthy. A patient whose arteries are clogged could potentially suffer a heart attack or stroke.

37. With respect to **Claim 2**, "**Tsai et al**., teaches and suggests "the steps of acquiring K space data at the first TE and the second TE comprise acquiring signal components from first and second chemical species", because background water and flowing sample signals are detected. [See col. 3 line 15 through col. 5 line 15, abstract, figure 6] **Chen et al**., also teaches this limitation because oil and water signals are separately detected with the two interecho spacings. [See **Chen et al**., abstract, col. 1 line 10 through col. 10 line 64; figures 1, 2]. Additionally **Pauly et al.,** teaches this limitation because each of the individual identifiable features / the identifiable species being imaged (i.e. at least two distinguishable features / species) are always reproduced correctly. [See col.

7 3-17]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 2** and need not be reiterated.

38. With respect to **Claim 3, "Tsai et al.**, teaches and shows "acquiring K space data at a third TE". [See the TE delays of –2ms 0ms and 2ms figures 8a, 8b, 8c, 9; and col. 4 lines 23-54] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 3** and need not be reiterated.

39. With respect to **Claim 4, "Tsai et al.**, teaches and shows "acquiring K space data at the third TE comprises acquiring signal components from the first and second chemical species" because background water and flowing sample signals are detected for each of the TE delays. [See col. 3 line 15 through col. 5 line 15, abstract, figures 4, 6, 8a, 8b, 8c and 9]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 3** also apply to **claim 4** and need not be reiterated.

40. With respect to **Claim 5, Tsai et al.**, shows that "estimating off resonance effects comprises generating an estimated field map" [See figures 2b, 3b, 6; col. 3 lines 1-29]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 5** and need not be reiterated.

41. With respect to **Claim 6, Tsai et al.**, suggests the steps of: "a) estimating the off resonance effects for a first location" [See the central box about the origin of figure 1a which is enlarged in figure 2a which shows the locations of estimated ideal sampling locations (circles) versus the actual sampled points (stars) at a first location" (i.e. the origin) "comprising: i. providing a frequency", [The examiner notes that an image mapping of k-space is necessarily a mapping of the frequency domain. Additionally, **Tsai et al.**, teaches that mis-registration problems increase as the slew rate, strength, and the sampling frequency of data acquisition increase. Therefore the **Tsai et al.**, reference provides both a sampling frequency for k-space, and a teaching of changing the sampling frequency by increasing it. [See col. 4 lines 56-59] "ii. estimating signal components for first and second chemical species" (i.e. the flowing water inside

the glass tube, and the stationary water background) at the provided frequency", [See col. 4 line 35 through col. 5 line 15; the examiner notes that the flowing sample is estimated to have a measurable velocity of about 79 cm/s that is distinguishable from the background water, in the **Tsai et al.**, experiment while the estimated velocity signal of the stationary components is zero. The reason the estimated velocity indication for the stationary background water in the **Tsai et al.**, experiment is intrinsically zero is because a stationary object theoretically has no velocity as one of ordinary skill in the art would already be knowledgeable of.]

42. **Tsai et al.**, also teaches "iii. calculating an estimated signal of the first and second chemical species at the provided frequency, [See col. 4 line 35 through col. 5 line 15; figure 9, the examiner notes that the calculated flowing sample was distinguished from the background water, [See figure 9] because there is no separate velocity indication plotted for the stationary background sample in figure 9. Therefore, the examiner interprets the stationary water to actually satisfy the estimated theoretical ideal of intrinsic zero velocity. Therefore figure 9 is interpreted by the examiner as indicating that the calculated velocity of the flowing signal components,(i.e. "first species") with a zero velocity being intrinsically understood for the stationary water , (i.e. "second species") "background components".] The step of "iv. calculating the difference between the estimated and acquired signal at the provided frequency", is illustrated by figure 3b with the **δk and arrow;** figure 9 where centered and off-centered k-space trajectory results are compared and taught in col. 3 lines 1-56] "and v. repeating steps i. - iv. for different frequencies" [See col. 4 lines 56-59 where the sampling frequency may be increased} "to find the frequency that minimizes the difference for the first location;" [See figure 1a, 1b where the plurality ok spiraling k-space lines suggests repetition, col. 3 lines 15 through col. 5 line 15. The examiner considers approximations to be equivalent to estimations.] "and b. repeating steps i. - v. for other locations in the estimated field map." [See the plurality of k space field lines in figures 3a, 3b; col. 3 line 1 through col. 5 line 15

The examiner considers approximations to be equivalent to estimations.] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5** also apply to **claim 6** and need not be reiterated.

43. With respect to **Claim 7, Tsai et al**., shows that "a region growing" is used :to create a frequency field map for the scanned object" because the k space field map increases spiraling from the center outwards. [See figures 1a, 1b, 3a, 3b]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6** also apply to **claim 7** and need not be reiterated.

44. With respect to **Claim 8, Tsai et al**., shows "a frequency determined region as the value of fj (i.e. the kc value) that minimizes Dlocal where Dlocal takes the single minimum in the Dlocal-fj plot." [See col. 3 line 15 through col. 5 line 15; figures 3a, 3b, and figure 9 which shows that by using the off-centered kc value the delay no longer changes the magnitude of the detected signal velocity.] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6, 7** also apply to **claim 8** and need not be reiterated.

45. With respect to **Claim 9**, **Tsai et al**., suggests and shows "expanding the frequency determined region so that the frequency field map can be created for the scanned object region" because the frequency determined region of k-space expands away from the origin in figures 1a, 1b and expands away from value kc in figures 3a, 3b.] Additionally **Pauly et al.,** suggests this limitation [See **Pauly et al.,** col. 7 line 18 through col. 8 line 6 where expanding k-space with interleaving annular rings to ensure a complete field of view is taught. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6, 7, 8,** also apply to **claim 9** and need not be reiterated.

46. With respect to **Claim 10**, **Tsai et al.**, suggests and shows from the figures and col. 3 line 1 through col. 5 line 15, "finding the correct frequency fj at each pixel in a "frequency to-be-determined region" (i.e. figures 1a, 3a) "which abuts the 'frequency determined' region [See **Tsai et al.**, the measured frequency sampled points (stars) in figures 1b, 3b, additionally see **Tsai et al.**, figures 2a, 2b where the measured stars on the since pulse abut the estimated

ideal circles of the since pulse, and col. 3 line 1 through col. 5 line 15]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6, 7, 8, 9,** also apply to **claim 10** and need not be reiterated.

47. With respect to **Claim 11**, **Tsai et al.**, suggests "finding the correct frequency fj comprises choosing the value of fj at each pixel that borders the frequency determined region which creates a local minima in the Dlocal-f. plot, and is the closest to the average local frequency of the neighboring pixels in the frequency determined region". [See col. 5 lines 1-9 where the phase contrast method measures the summed signal of the velocity encoded spins and the shading (i.e. blurring, off-resonance) artifacts caused by the larger stationary background generate partial volume effects to each pixel within the region from which the signal in detected in the blood vessel or glass tube. [See col. 4line 35 through col. 5 line 15; and the ideal and measured plots of figures 1a, 1b, 3a, 3b; along with the explanation of how to choose the displacement see col. 3 line 1 through col. 4 line 34.] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6, 7, 8, 9, 10,** also apply to **claim 11** and need not be reiterated.

48. With respect to **Claim 12**, **Tsai et al.**, suggests and shows that "a. estimating the off resonance effects for a first location comprising: i. providing a frequency", ii. estimating signal components for first and second chemical species at the provided frequency", for the same reasons given with respect to **claim 6**, that need not be reiterated. **Tsai et al.**, suggests the feature of "iii. determining whether the signal components have the same or opposite phases at the provided frequency", because **Tsai et al.**, teaches that in a phase contrast implementation the phase polarity, or direction of the detected signals can either overestimate or underestimate the flow velocity of the sample, and **Tsai et al.**, teaches two method implementations one using bipolar gradients to provide directional flow compensation, and the other for unipolar excitation if the sample is free of flowing material, (i.e. a bipolar pulse is utilized if there are

opposite phases interacting, and a unipolar pulse is used if there is only one net phase interacting. [See col. 3 line 15 through col. 5 line 15]

49. **Tsai et al.**, suggests the limitation of "repeating i. - iii. for another frequency if the signal components do not have the same or opposite phases, and b. repeating steps i. - iv. for other locations in the estimated field map" because of the plurality of k space spiral measurements made in figures 1a, 1b, 2a, 3a, 3b, 6 and figure 9 where the process is repeated for three different TE delays. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5, 6** also apply to **claim 12** and need not be reiterated.

50. With respect to **Claim 13**, **Tsai et al.**, suggests "using an off resonance correction method to eliminate the effects of local Bo inhomogeneity on the first chemical species" (i.e. the flowing water). [See col. 3 lines 1-62 using a bipolar gradient pulse]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 13** and need not be reiterated.

51. With respect to **Claim 14, Tsai et al.**, suggests, "using an off resonance correction method to eliminate the effects of local Bo inhomogeneity on the second chemical species. (i.e. the stationary background water) [See col. 3 lines 1-62 using a unipolar gradient pulse]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 14** and need not be reiterated.

52. With respect to **Claim 15**, **Tsai et al.**, suggests "using an off resonance correction method to eliminate the effects of local Bo inhomogeneity on the first chemical species" (i.e. the flowing water), "and the second chemical species" . . (i.e. the stationary background water) of the **Tsai et al.**, experiment [See figure 4, where the gradients alternate from being bipolar initially to being unipolar over the data acquisition sequence, col. 3 lines 1-62, abstract, and col. 4 lines 35 through col. 5 line 15 where phase-contrast methods for flowing and stationary spins are taught. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1** also apply to **claim 15** and need not be reiterated.

53. With respect to **Claim 16**, **Tsai et al.**, suggests and shows from figures 5a, 5b, 5c, 5d, 7a, 7b, 7c, 7d, 8a, 8b, 8c, and 9 the step of "reconstructing images of the first" and / or "second chemical species based on frequencies indicated in the frequency field map at each pixel location having blurring due to the off resonance effects of local Bo inhomogeneity." [See figures 1 through 9; col. 2 line 11 through col. 5 line 15]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 5,** also apply to **claim 16** and need not be reiterated.

54. With respect to **Claim 22**, **Tsai et al.**, teaches and shows the step of "acquiring a plurality of interleaves" [See figures 3a, 3b, 1a, 1b col. 3 line 25 through col. 4 line 54], "wherein each interleave uses a different TE" [See figure 4] "and the sampling density of each interleave is sufficient to create a low resolution image" [See figures 6, 8b, 8c].]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 1,** also apply to **claim 22** and need not be reiterated.

55. With respect to **Claim 23**, **Tsai et al**., teaches and shows the step of "the sampling density of each component sufficiently over samples" (i.e. over estimates) "k space to create a low resolution image of the object at that TE" [See col. 3 lines 15-57; figures 6, 8b, 8c].]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1, 22,** also apply to **claim 23** and need not be reiterated.

56. **Claims 21** is rejected under **35 U.S.C. 103(a)** as being unpatentable over **Zhang et al.**, US patent 6,263,228 B1 issued July 17th 2001.

57. With respect to **Claim 21**, **Zhang et al**., teaches "using more than one coil for obtaining the data sets" [See figure 1, the multiple RF coils 14, and the multiple gradient coils 12]. **Zhang et al**., teaches "using a weighted average from signals of each coil when minimum local difference between acquired signals" [See col. 5 line 10 through col. 10 line 20] **Zhang et al**., lacks teaching directly that the equation used for the "estimated signals is D.sub.pixel=.vertline.S.sub.0-({overscore (W)}'.sub.j+{overscore

(F)}'.sub.j).vertline.+.vertline.S.sub.1-({overscore (W)}'.sub.j+{overscore (F)}'.sub.j exp(i.phi..sub.fat))exp(i.phi..sub.j-).vertline.+.vertline.S.sub.2-({overscore (W)}'.sub.j+{overscore (F)}'.sub.j exp(i2.phi..sub.j))exp(i2.phi..sub.j).vertline", However It would have been obvious to one of ordinary skill in the art at the time that the invention was made that applicant's region growing and polynomial fitting equations accomplish the same thing. Therefore, the examiner considers the **Zhang et al**., equations to be equivalent to the equation claimed by applicant in **claim 21**. The same reasons for rejection, that apply to **claim 1** also apply to **claim 21** and need not be reiterated.

Prior art of record

58. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

A) **Zhang** US patent 6,459,922 B1 issued October 1st 2002 filed March 30th 1999. [The entire reference is relevant to applicant's claims]..

B) **Kwok et al.,** article: "Interleaved Water and Fat Dual-Echo Spin Echo Imaging with Intrinsic Chemical-Shift Elimination", Journal of Magnetic Resonance Imaging 13: 318-323 (2001).

C) **Kwok et al.,** US patent 6,583,623 B1 issued June 24th 2003, filed March 30th 2001, which corresponds to the **Kwok et al.,** article.

D) **Zhang et al.,** US patent application publication 2003/0060697 A1 published March 27th 2003, filed August 10th 2001.

E) **Zhang et al.,** US patent 6,603,990 B2 issued August 5th 2003, filed August 10th 2001 which corresponds to US patent application publication 2003/0060697 A1 published March 27th 2003, filed August 10th 2001.

F) **Ma** US patent 6,016,057 issued January 18th 2000.

G) **Meyer et al.,** US patent 6,020,739 issued February 1st 2000.

H) **Pauly** US patent 5,270,653 issued December 14th 1993.

I) **Heid** US patent 6,486,670 B2 issued November 26th 2002, filed April 2nd 2001.

J) **Heid** US patent application publication 2001/0026157 A1 published October 4th 2001, filed April 2nd 2001.

K) **Durek et al.,** US patent application publication 2005/0017717 A1 published Jan. 27th 2005, which is the corresponding publication of applicant's instant application, and although not prior art this reference is noted for the purposes of a complete record.

Conclusion

59. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

60. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(703) 872-9306**.

Tiffany A. Fetzner
TAF
February 1, 2005

Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800